



Environment, Energy, Security & Sustainability

Symposium and Exhibition



The Benefits of Implementing Low Impact Development at DoD Facilities

Denver, Colorado

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Outline



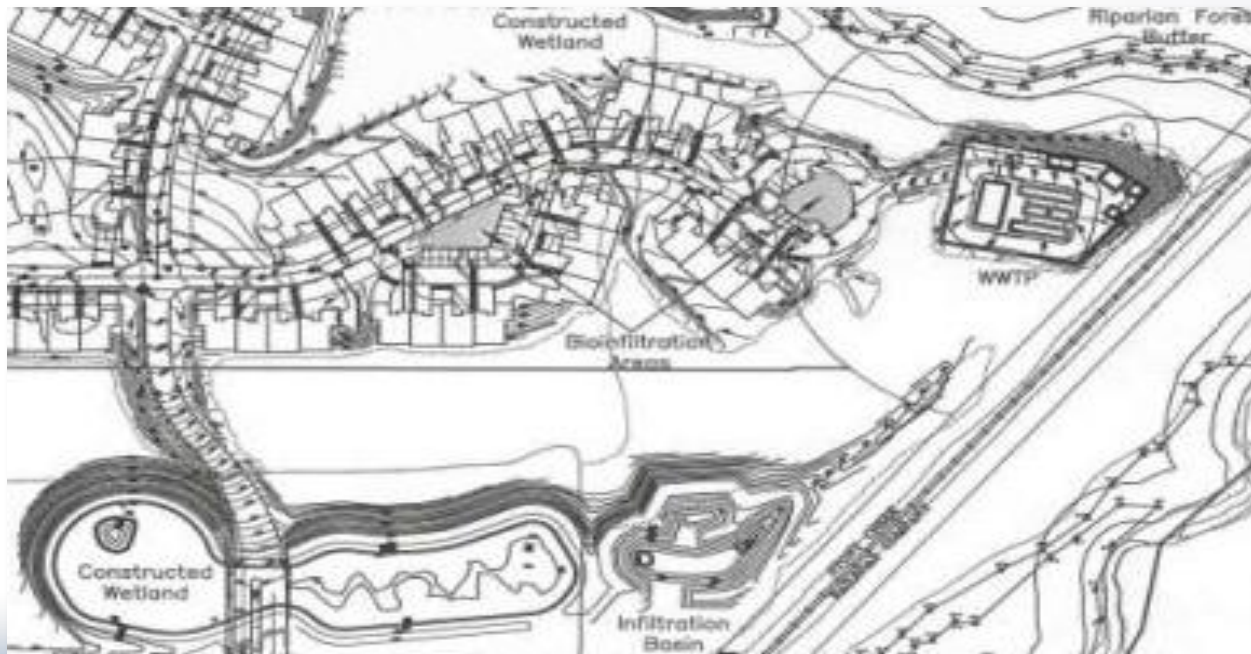
- LID Definition
- LID Benefits
- Regulatory Background, News, Trends
- Fort Stewart LID Project
- Design Considerations
- Cost Effectiveness
- Questions and Discussion



LID Definition



- Low Impact Development (LID) is a stormwater management strategy that maintains or restores the original site hydrology through infiltration, evapo-transpiration or reuse of stormwater.





Better LID Definition



Keep Rain Water From Becoming Stormwater!!





Structural LID Strategies (BMPs)



- Permeable Pavements
- Stormwater Harvesting
- Bio Retention (Infiltration)
- Rain Gardens
- Green Grid





LID Benefits



- Reduced Land Area Required for Development
- Watershed Protection and Groundwater Recharge
- Regulatory Stormwater Compliance by Reduced Pollutants, Total Flow and Peak Flow
- Sustains Existing Infrastructure
- Leadership in Environmental Energy and Design (LEED) Credits



LEED Credits



- Construction Site Pollution Prevention
- Habitat Protection/Restoration
- Maximize Open Space
- Control Stormwater Quantity and Quality
- Use of Water Efficient Landscaping
- Heat Island Effect



Stormwater

A Growing Concern

- 1982 - 1997 - 25 Million Acres was Developed (15 yrs)
 - 25% of ALL Developed Land in the United States
- 2000 to 2025 - 68 Million Acres
- Stormwater is one of the leading sources of pollution for all water bodies in the United States

Urban Stormwater Management in the United States, National Research Council (NRC) Oct. 2008



Regulatory Background



- Clean Water Act (CWA)
- National Pollution Discharge Elimination System (NPDES) – Reduce Industrial and Municipal Sewage Discharge (Point Source)
- 1987 Section 402(p) CWA - Address Pollution From Stormwater (Non-Point Source)
- 1990 - NPDES Phase I Rules – MS4s >100,000
- 1999 - NPDES Phase II Rules – Small MS4s



Regulatory News and Trends



Construction Stormwater Discharge

- Feb. 1, 2010 – EPA Final Rule For Effluent Limitation Guidelines (ELG) and New Source Performance Standards (NSPS) for Construction Runoff (280 NTU)
 - Aug. 1, 2011 – Disturbed Area 20 Ac. +
 - Feb. 2, 2014 – Disturbed Area 10 Ac. +
- Once Fully Implemented
 - Reduction of 4 Billion pounds/yr
 - Annual Cost \$953 Million



Regulatory News and Trends



Post-Construction Stormwater Discharge

- Fall 2012 – EPA To Develop ELG Rule
 - What **Could** The New Rule Require?
 - Pre development hydrology mimics post development Hydrology
 - LID practices may be mandated through the state construction general permits.
- “The lack of requirement for post-construction stormwater controls in the construction industry's general permit is a glaring shortcoming” and calls for "radical changes to EPA's stormwater control program”.



Regulatory News and Trends



- January 2009 – EPA Determination Florida Numeric Nutrient Water Quality Standards (1st in the US)
- October 2010 - Final Standards
 - Lakes and flowing waters
- October 2011 Final Standards
 - Estuarine and Coastal Waters



Federal Guidance For LID



- Executive Orders and EPA Guidance
 - Section 438 Energy Independence and Security Act (EISA) Dec. 2007.
 - EPA 841-B-09-001 “*Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*”, Dec. 2009 (Executive Order 13514)



EISA Section 438



- Storm Water Runoff Requirements for **Federal** Development Projects.

“The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow.”



DoD Leadership Implementing Section 438



OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

NOV 19 2009

MEMORANDUM FOR ACTING ASSISTANT SECRETARY OF THE ARMY
(INSTALLATIONS AND ENVIRONMENT)
ACTING ASSISTANT SECRETARY OF THE NAVY
(INSTALLATIONS AND ENVIRONMENT)
ACTING ASSISTANT SECRETARY OF THE AIR
FORCE (INSTALLATIONS, LOGISTICS, AND
ENVIRONMENT)

SUBJECT: DoD Implementation of Storm Water Requirements under Section 438 of
the Energy Independence and Security Act (EISA)

Reducing the impacts of storm water runoff associated with new construction helps to sustain our water resources. In October 2004, DoD issued Unified Facilities Criteria on Low Impact Development (LID) (UFC 3-210-10), a storm water management strategy designed to maintain the hydrologic functions of a site and mitigate the adverse impacts of storm water runoff from DoD construction projects. Using LID techniques on DoD facility projects can also assist in fulfilling environmental regulatory requirements under the Clean Water Act. Since 2004, DoD has implemented LID techniques for controlling storm water runoff on a number of projects.

EISA Section 438 (Title 42, US Code, Section 17094) establishes into law new storm water design requirements for Federal development and redevelopment projects. Under these requirements, Federal facility projects over 5,000 square feet must "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow." Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (October 5, 2009), directed the U.S. Environmental Protection Agency (EPA) to issue EISA Section 438 guidance. DoD shall implement EISA Section 438 and the EPA *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*, using LID techniques in accordance with the policy outlined in the attachment.

EISA Section 438 requirements are independent of storm water requirements under the Clean Water Act and should not be included in permits for storm water unless a State (or EPA) has promulgated regulations for certain EISA Section 438

requirements (i.e., temperature/heat criteria) that are applicable to all regulated entities under its Clean Water Act authority.

The attached policy will be incorporated into applicable DoD Unified Facilities Criteria within six months. My points of contact are Thadde Buzan at (703) 571-9079 and Ed Miller at (703) 604-1765.

Dorothy Robyn
Deputy Under Secretary of Defense
(Installations and Environment)

Attachment:
As stated

**"DoD shall implement EISA
Section 438 using LID
techniques in accordance
with the policy outlined in the
attachment."**



EISA Section 438

Flowchart for EISA §438 Implementation

1. Determine applicability

Requirement: apply to all Federal projects with a footprint greater than 5,000 square feet

2. Establish design objective

Requirement: maintain or restore predevelopment hydrology

OPTIONS

1
Total volume of rainfall from 95th percentile storm is to be managed on-site.

2
Determine predevelopment hydrology based on site-specific conditions and local meteorology by using continuous simulation modeling techniques, published data, studies, or other established tools. Determine water volume to be managed onsite.

Design water volume
(to be retained)

3. Evaluate design options

Design water volume
(to be retained)

Requirement: meet design objective to maximum extent technically feasible (METF)

TYPICAL ON-SITE DESIGN OPTIONS

Bio-retention areas
Permeable pavements
Cisterns / recycling
Green roofs

Use any combination of on-site options to achieve the design objective to the METF. Document site-specific constraints.

Selected on-site design options

remaining water volume?

OFF-SITE OPTIONS
(optional)

Selected off-site design options

TECHNICAL CONSTRAINT EXAMPLES

- Retaining storm water on site would adversely impact receiving water flows
- Site has shallow bedrock, contaminated soils, high groundwater, underground facilities or utilities
- Soil infiltration capacity is limited
- Site is too small to infiltrate significant volume
- Non-potable water demand (for irrigation, toilets, wash-water, etc.) is too small to warrant water harvesting and reuse systems
- Structural, plumbing, or other modifications to existing buildings to manage storm water are infeasible
- State or local requirements restrict water harvesting
- State or local requirements restrict the use of green infrastructure/LID

4. Finalize design and estimate cost





Fort Stewart LID Project





Project Goal



- Goal: Demonstrate the Benefits For Stormwater Volume Reduction and Quality Improvement Using LID Methods to Retrofit Two Existing Parking Areas

“Everyone seems to talk LID but folks won’t do it unless they see it in the ground. Walking the LID walk was what this project was about.”

*Russell Moncrief, Fort Stewart/Hunter Army Airfield Stormwater Program Manager
ICPI Magazine, Sept, 2009*



Project Scope



➤ Scope Elements

- Design of LID BMPs
- Pre and Post LID Stormwater Monitoring
- Drawings and Specifications
- Construction Management
- Construction Quality Control



Design Basis Paradigm Shift



- Conventional Stormwater Design
 - Flood Control
 - Stormwater Disposal
- LID Design
 - Account for Flood Control
 - Maximize Infiltration for Most Frequent Rain Events
 - Stormwater is a Resource Not a Disposal Issue
- Stormwater Stewardship



LID Design Considerations



- Stormwater Management Objectives
 - EISA, Water Quality Volume, TMDLs
- Site Specific Conditions
 - Soil Properties - Hydraulic and Structural
 - Water Table Elevation and Nearby Waters
 - Planned Development for Surrounding Area
- Design Limitations & Alternatives
 - Hot Spots
 - Topography
 - Adjacent Structures and Infrastructure
- Structural and Non-Structural BMPs

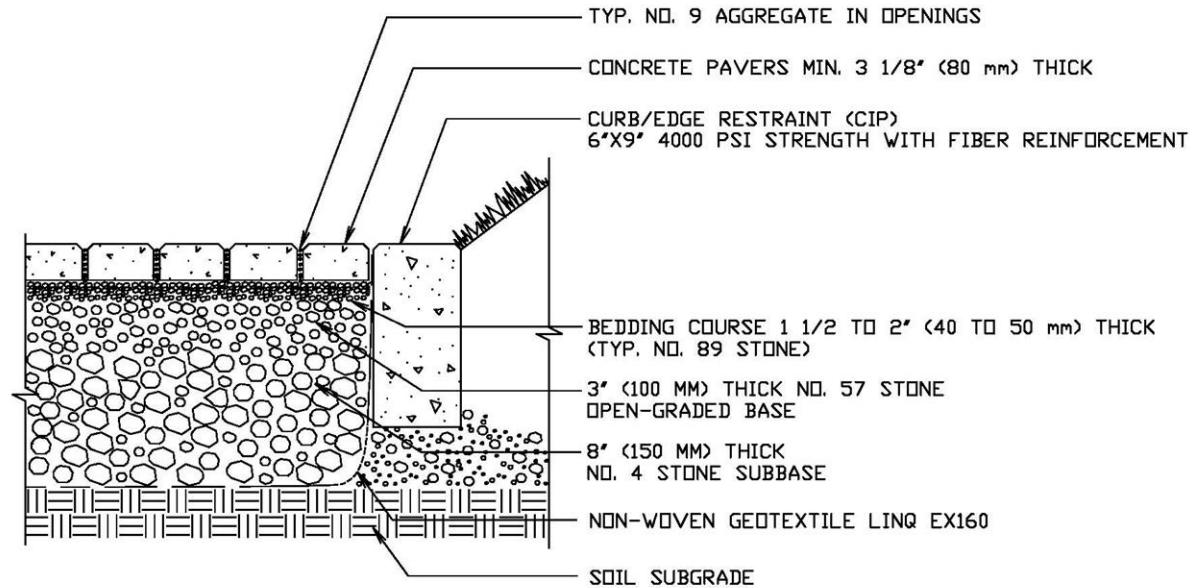


Fort Stewart LID Project





Permeable Pavement Design Cross Section



PERMIABLE INTERLOCKING CONCRETE PAVEMENT CROSS SECTION
WITH CONCRETE EDGE RESTRAINT
N.T.S



Pre-LID: Concentrated Runoff





Recycle Asphalt Excavate Soil Subbase





Construction Quality Control





Geotextile & Aggregate Layers





Interlocking Paver Installation





Finished Interlocking Concrete Pavement





Before / After





Rain Garden





Rain Garden & Dumpster Pad





Rain Garden





Rainwater Harvesting



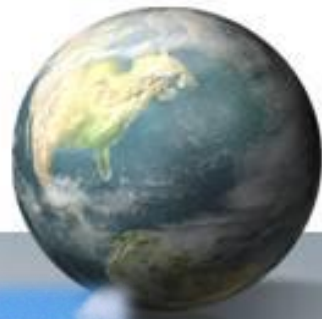


Parking Area – Pre LID





Interlocking Concrete Pavement





Gravel Pavement





Gravel Pavement





Gravel Pavement





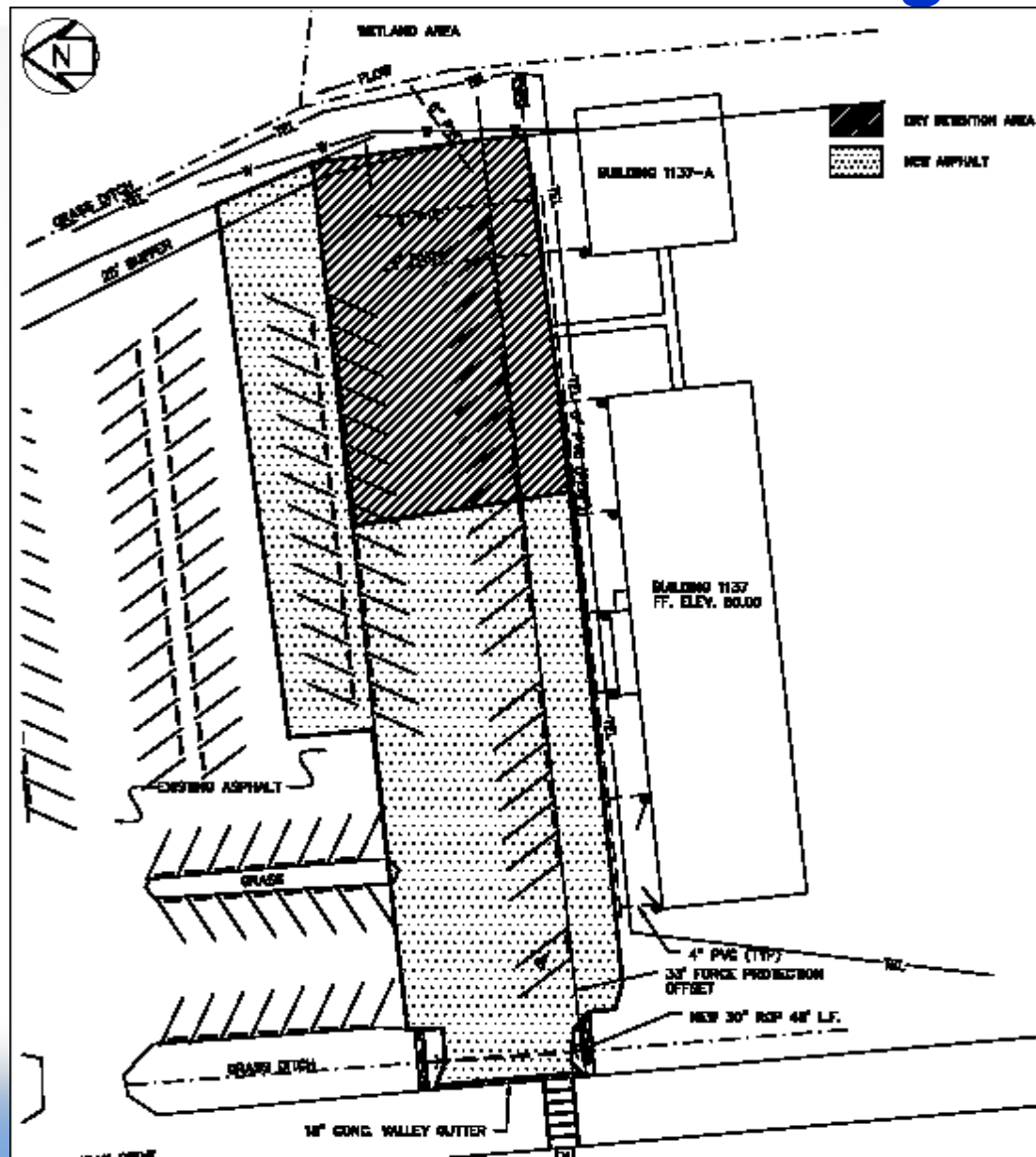
Cost Effectiveness #1



- Cost Comparison between Conventional (Impervious) Pavements and Permeable Pavement for the Retrofit of 22,000 SF of an Existing Asphalt Parking Area
- Minimum Service Life of Asset - 50 Years
- Use Life Cycle Cost Analysis (LCCA)
- Impervious Pavement Design
Requires Stormwater Detention Pond,
Drop Inlet Structures and Buried Pipe

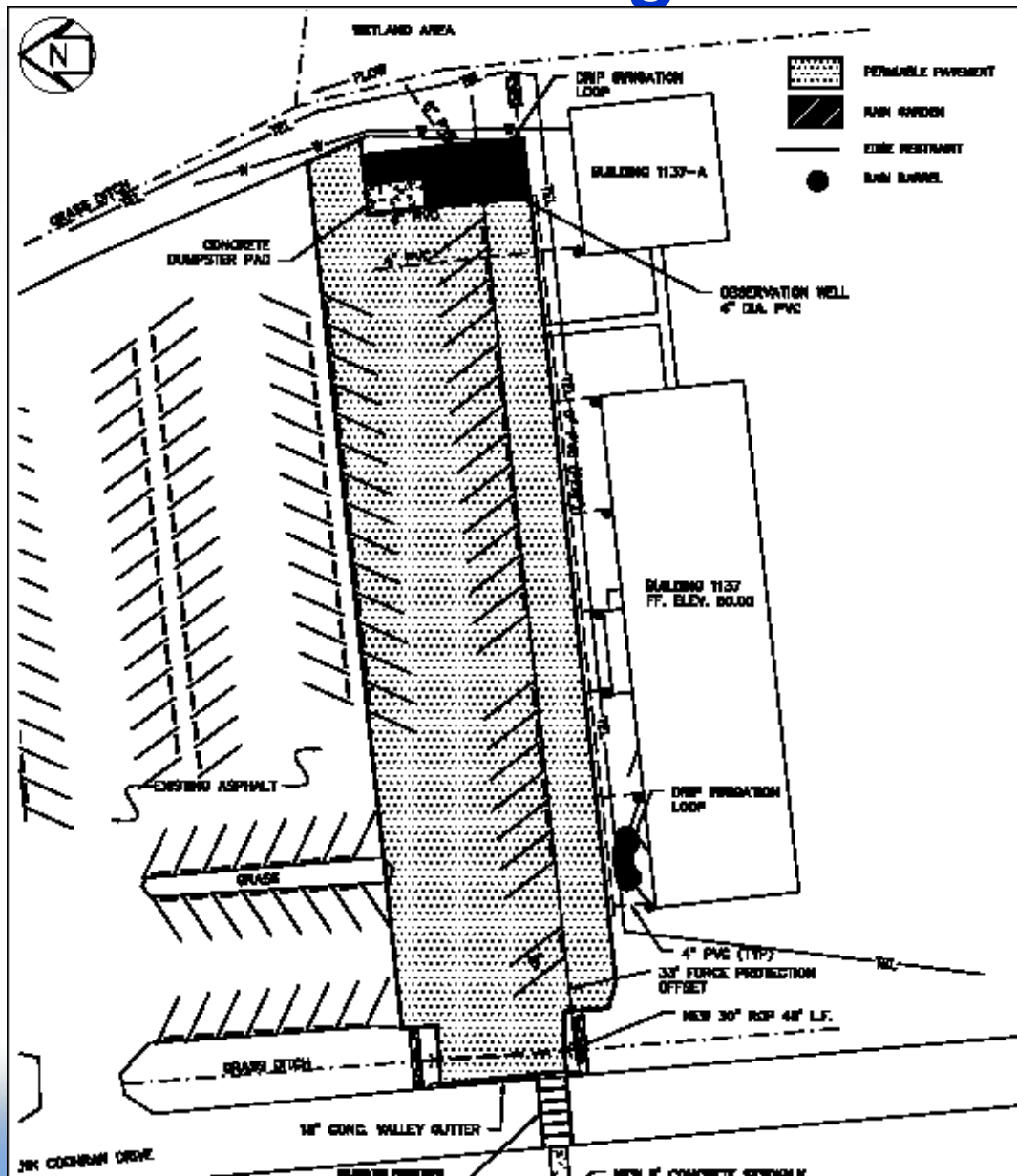


Conventional Design





LID Design





Cost Effectiveness



Initial Construction Cost	Asphalt Pavement	Concrete Pavement	Interlocking Concrete Pavement
Soil Subbase Preparation	\$40,000	\$40,000	\$40,000
Installation of New Pavement System	\$2.84/SF \$62,600	\$4.88/SF \$107,400	\$7.70/SF \$163,400
Installation of Stormwater Infrastructure	\$15,000	\$15,000	0
Initial Construction Costs (ICC)	\$117,600	\$162,400	\$203,000
Life Cycle Cost Analysis (LCCA)	Asphalt Pavement	Concrete Pavement	Interlocking Concrete Pavement
Design Life (years)	25	30	45
Estimate Annual Maintenance (50 Yr Service Life)	\$6,000 (2)	\$3,000 (2)	\$1,000
Replacement Interval Factor	2.0	1.67	1.11
Replacement Cost	\$125,200	\$179,400	\$181,400
Avoided Costs	-	-	Land Area Not Required For Dry Detention Basin
Total Cost - LCCA (5)	542,800	\$491,800	\$434,400



Cost Effectiveness Results



- LCCA Shows Permeable Pavements Are More Cost Effective Than Conventional Pavements (Pavement Alone)
- Land Value Associated With Smaller Development Footprint
- Stormwater Compliance
- Non-Monetary Benefits
 - Public Perception of Excellence in Stewardship of our Natural Resources which leads to Employee Productivity



Cost Effectiveness #2



- EPA Study “Reducing Costs Through Low Impact Development (LID) Strategies and Practices”, EPA 841-F-07-006 (Dec. 2007)
 - ***“In 15 of the 17 case studies presented in this report showed that LID practices reduced project costs by 15% to 80% and improved environmental performance. “***



LID Benefits For Stakeholders



- Improves Stormwater Quality - Removal of Pollutants and Reduction of Peak Flows for most frequent storm events
- Environmental - Regulatory Compliance (NPDES) Water Quality, TMDLs, Temperature
- Engineering - Stormwater Design, Peak Flow Reduction
- Master Planning - Land Use, Economic Analysis (LCCA)



Questions/Discussion

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